The effect of marinade with essential oils on the microbial shelf life of fish and meat

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Introduction

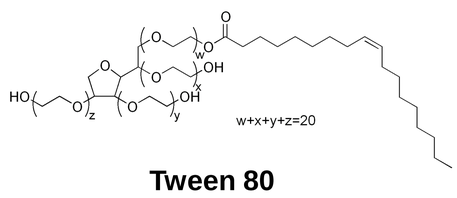
Fresh and minimally processed fish and meat are easy targets for microbial spoilage. The antimicrobial action of marinades is based on lowering the pH and the water activity, presence of antimicrobials in added herbs and the use of certain food additives (sorbate, benzoate). Due to green consumerism the demand for natural alternatives to synthetic additives increases and a considerable amount of research concerning the antimicrobial properties of **essential oils (EO)** has and is being done. **In this study, EOs in marinades were used on fish and meat and the effect on the microbial growth during storage was assessed.**

Experimental Setup

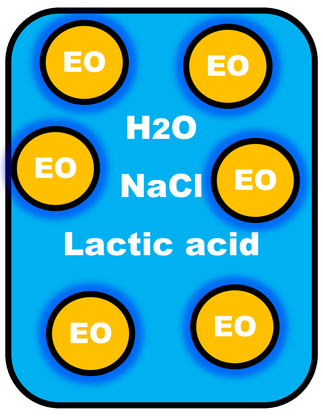
Cinnamon EO
(Cinnamomum zeylanicum)

Oregano EO
(Origanum compactum)

Thyme EO
(Thymus zygis ct thymol)



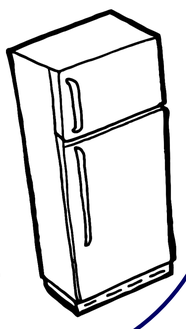
Tween 80
(surfactant)



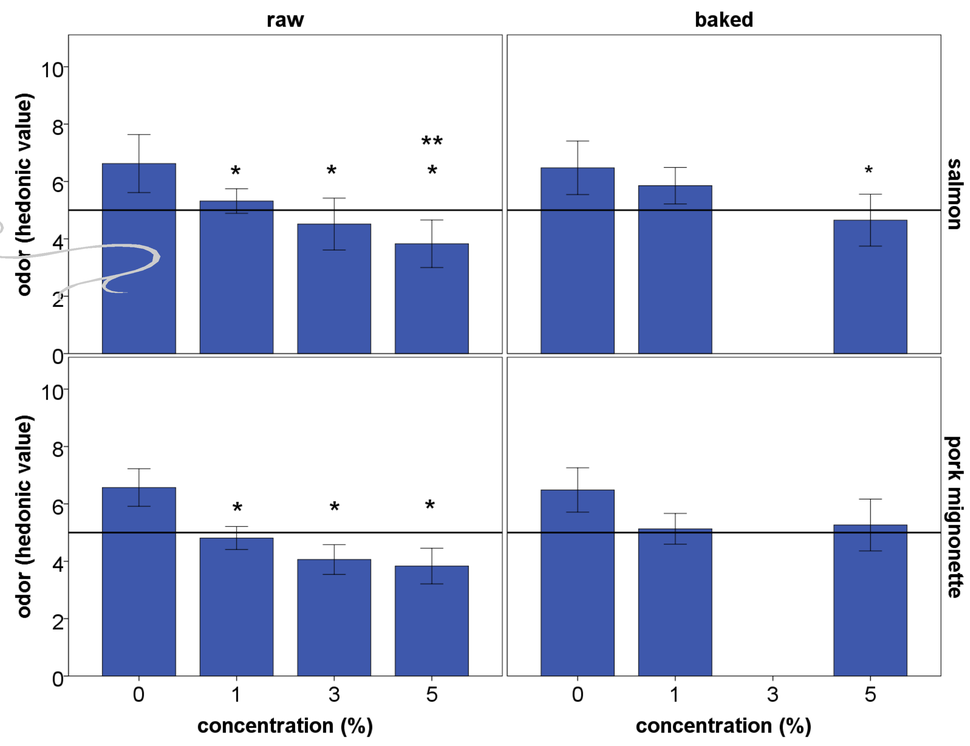
MARINADE
10 % NaCl
2 % lactic acid/NaLactate
1 % essential oil
0.2 – 1.2 % Tween 80
pH 4.5

Marinating by submersion

Storage in air
4 °C



What is the influence of marinating with EO on the odor and general visibility of the meat/fish after 24 h?



Error Bars: 95% CI

Hedonic value (0 = extremely bad; 10 = extremely good) of the odor of marinated salmon and pork mignonette; * = significantly different ($p < 0.05$) from 0 % EO; ** = significantly different from 1 % EO (n = 247)

- **Concerning general visibility, no differences were observed between samples marinated with 0 to 5 %EO.**
- **When baked, the use of 1% EO in marinade did not result in adverse odors, whereas 5% EO was less well perceived in some cases.**

How much marinade/essential oil is transferred to the meat/fish by submersion (i.e. pick-up)?

	pick-up marinade g/100 g	pick-up EO g/100 g
chicken skin	9.0±4.1	0.09
chicken fillet	4.9±2.4	0.05
pork back fat	4.2±3.0	0.04
pork mignonette	3.0±1.6	0.03
salmon	1.8±2.0	0.02
scampi	0.9±0.6	0.01

- **Great variability in pick-up of marinade among different food matrices (n=188).**
- **No clear correlation between pick-up and fat/protein/water content.**

Does the marinade with essential oil inhibit the growth of spoilage microflora on meat/fish?

	chicken skin	chicken fillet	pork back fat	pork mignonette	salmon	scampi
total coliforms	C	/	C,O,T	NG	NA	NA
E. coli	/	NG	NG	NG	NA	NA
yeast & molds	C	C	C	C,O,T	C	NG
lactic acid bacteria	C	C	/	/	/	O,T
total psychr. counts	NA	NA	NA	NA	/	/

Growth inhibition during storage when applying 1% EO in the marinade, green letters expressing the presence of growth inhibition due to that EO; C = cinnamon, O = oregano, T = thyme, NG = no growth, NA = not applicable, / = no growth inhibition (n=3)

- **Despite the low pick-up of EO (0.01 to 0.09 g EO/100 g) growth inhibition occurred in some cases, whereas the marinade (acid, NaCl) without EO showed no growth inhibiting potential.**
- **Cinnamon EO showed the broadest antimicrobial spectrum.**
- **Cinnamon EO was consistently efficient against yeasts and molds.**

Conclusion

The use of essential oils at low levels (1 % EO in marinade, substantially lower pick-up) shows some potential for growth inhibition when used in a marinade on meat and fish surfaces. The use of 1 % EO does not result in significant adverse odors or general visibility, whereas 5 % EO does in some instances, suggesting a maximal applicable EO concentration somewhere in between. The next steps are to check the potential of combined use of MAP packaging and EO, and whether NaCl/lactic acid actually contribute towards the growth inhibiting effect when EOs are applied. **This study was made possible by the agency for Innovation by Science and Technology (TETRA 130214) and the participating companies.**

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